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NEW HAMPSHIRE COLLEGE

AGRICULTURAL EXPERIMENT STATION

EIGHTH ANNUAL REPORT

BY CHARLES S. MURKLAND

NEW HAMPSHIRE COLLEGE

OF

AGRICULTURE AND THE MECHANIC ARTS

DURHAM, N. H.

NEW HAMPSHIRE COLLEGE

OF

AGRICULTURE AND THE MECHANIC ARTS

AGRICULTURAL EXPERIMENT STATION

DURHAM, N. H.

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The Bulletins of this Station are sent free to any resident of New Hampshire upon application.

EIGHTH ANNUAL REPORT

The eighth annual report of the New Hampshire College Agricultural Experiment Station, for the year ending November 1, 1896, is hereby respectfully submitted,

CHARLES S. MURKLAND,
Acting Director.

ANNUAL STATEMENT

Of the Hatch Fund of the New Hampshire College of Agriculture and the Mechanic Arts, for the year ended June 30, 1896.

RECEIPTS

Cash received from United States treasurer	$15,000.00

EXPENDITURES

Cash paid for salaries	$8,010.00	
labor	1,395.26	
publications	608.34	
postage and stationery	37.78	
freight and express	221.10	
heat, light, and water	495.76	
chemical supplies	165.02	
seeds, plants, and sundry supplies	324.27	
fertilizers	243.44	
feeding stuffs	1,040.41	
library	4.66	
tools, implements, and machinery	846.51	
furniture and fixtures	175.33	
scientific apparatus	258.07	
live stock	93.72	
traveling expenses	496.26	
contingent expenses	191.47	
building and repairs	392.60	
		$15,000.00

SUPPLEMENTARY STATEMENT

RECEIPTS

Cash received from the State Board of Agriculture for analysis of fertilizers .	$558.00	
Cash received from sales of farm produce	623.67	
		$1,181.67

EXPENDITURES

Cash paid for salaries . . .	$450.00	
labor	623.67	
chemical supplies . .	58.00	
scientific apparatus .	50.00	
		$1,181.67

We, the undersigned, duly authorized auditors of the corporation, do hereby certify that we have examined the books and accounts of the New Hampshire College Experiment Station for the fiscal year ending June 30, 1896; that we have found the same well kept and classified as above, and that the receipts for the year from the treasurer of the United States are shown to have been $15,000.00, and the corresponding disbursements $15,000.00; for all of which proper vouchers are on file and have been by us examined and found correct.

Also that the receipts from fertilizer analyses and farm receipts, have been duly expended and vouched for, as per supplementary statement.

And we further certify that the expenditures have been solely for the purposes set forth in the act of congress approved March 2, 1887.

(Signed)

JOHN G. TALLANT,
CHAS. S. MURKLAND,
Auditors.

Durham, N. H., August, 1896.

REPORT OF THE VICE-DIRECTOR AND CHEMIST

The membership of the Station council has continued unchanged throughout the year. The organization was changed May 1, 1896, by the appointment of F. W. Morse to the position of vice-director.

The position of clerk was made vacant May 1, 1896, by the resignation of Richard Fitzgerald and was filled June 1, by the appointment of Clement S. Morris.

Eight bulletins with a total of seventy-nine pages of printed matter have been published, as follows:

Bulletin 32, Studies of Maple Sap, by Fred W. Morse, 14 pages.

Bulletin 33, Two Shade-Tree Pests, by Clarence M. Weed, 7 pages.

Bulletin 34, Surface and Sub-Irrigation Out of Doors, by F. William Rane, 14 pages.

Bulletin 35, The Codling Moth and the Apple Maggot, by Clarence M. Weed, 7 pages.

Bulletin 36, Analyses of Three Common Insecticides, by Fred W. Morse, 3 pages.

Bulletin 37, Crimson Clover, by F. William Rane, 4 pages.

Bulletin 38, The Tent Caterpillar, by Clarence M. Weed, 15 pages.

Bulletin 39, The Army Worm in New Hampshire, by Clarence M. Weed, 15 pages.

The feeding experiments conducted during the year have been in charge of the writer and have included trials with milch cows, to determine the relative food values of different kinds of corn silage, and tests of the value of skim-milk as food for calves and pigs. The varieties of corn compared were Sanford, Leaming, and Mosby's Prolific, and further experiments with the same will be tried during the coming season. The trials with pigs and calves are also to be continued.

In the chemical laboratory, the most important work on account of time used, was the inspection of fertilizers for the secretary of the state board of agriculture. Two hundred and

sixty-seven samples of fertilizers were collected under the joint supervision of the secretary and the chemist. These samples represented one hundred and twelve distinct brands of fertilizers and chemicals from twenty-four different manufacturers. It was found necessary to employ extra assistance for the work and Mr. F. D. Fuller and Mr. C. W. Vickery were engaged for ten weeks.

In connection with the feeding experiments, numerous analyses of silage and of milk were made. The amount and nature of the acid in the silage was also studied in continuation of a series of experiments extending through several seasons. Methods for determining potash in fertilizers and for analyzing cattle foods were tested in coöperation with the Association of Official Agricultural Chemists, upon samples furnished by its reporters.

The amount of miscellaneous work for the public was greater this year than last, which was due to the increase in the number of samples of water sent to the station. One hundred and thirty-six miscellaneous samples were analyzed in all, eighty-four of which were water and twenty-five milk, while the remainder included soils, ashes, and other fertilizing materials, dairy products, cattle foods, and insecticides.

Two dairy tests were conducted by an assistant of this department, one with a herd competing for the prize offered by the Ayrshire Breeders' Association and the other with a single cow, in coöperation with the Holstein-Friesian Association. The results of these tests are published by the respective societies.

The chemist has been ably assisted in all the work of this department by Mr. Charles D. Howard. The work of the other departments of the station is summarized in the following pages.

Fred W. Morse,
Vice-Director and Chemist.

DEPARTMENTS OF AGRICULTURE AND HORTICULTURE

The work of the year has been largely that of organization. The head of the department lectured at twenty-five different places during the past year, chiefly before grange organizations. The assistant in horticulture lectured at ten places, and the assistant in agriculture at two places.

Two bulletins have been published from this department, "Surface and Sub-Irrigation Out of Doors," No. 34, and "Crimson Clover," No. 37.

Two general exhibits of the college crops in both agriculture and horticulture were made at fairs, the State Grange fair at Tilton, N. H., September 7 to 10; Rochester fair, September 21 to 26; also sent one plate each of fifty-six varieties of tomatoes to the State Horticultural Society at Concord September 22 to 24.

I. Agriculture

Early in the year the new barn was made ready for use. All of the animals were subjected to the tuberculin test before they were transferred. The two new silos which had been previously filled were opened and furnished abundant green food until late in the spring. The whole herd consisted of twenty-six animals.

Feeding experiments were carried on under the direction of the chemical department.

A number of valuable animals have been added to the herd from time to time throughout the year. We now have representative Ayrshires, Guernseys, and Jerseys, also Durhams and grade Holsteins.

The following experiments have been planned and carried out during the present season:

1. Kainit as an absorbent and for increasing the value of manure, compared with gypsum and sawdust. The manure with each absorbent was kept separate. In the spring a plot of each was planted under the same conditions with various plants, to ascertain their respective values. The experiment has not been concluded.

2. Fertilizing grass lands. In connection with the German Kali works, an experiment was undertaken to study further this question. Various forms and combinations of fertilizers were used in good sized plots. The experiment will require some time for completion.

3. Fertilizers on corn and potatoes to run one and two years respectively, one half of each plot being treated with a liberal dressing of lime.

4. Testing varieties of new forage crops. A number of the newer agricultural plants that had never been grown at the Station were sown in good-sized plots, that we might become familiar with their behavior and value in this climate. The varieties were Soja beans, spring vetch, lucerne, white lupines, seradella, crimson clover, sainfoin, Japanese millet, golden millet, spurry, Dwarf Essex rape, Jerusalem corn, Kaffir-corn, white milo maize, teosinte, sacaline; also four varieties of oats (Black Tartarian, Lincoln, American beauty, and white Maine).

5. Growing roots. As with forage crops a few roots were grown in plots, viz., two varieties of Wahauka sugar beets, two of carrots, long orange improved and white Belgian, mammoth long red beet, and Lane's improved sugar beet, purpletop white globe turnip and white French turnip, Jerusalem artichoke.

6. Fertilizers for soja beans. One of the two acres of this crop was set aside for a fertilizer experiment. It was divided into quarter-acre plots and each was fertilized as follows: two according to two different formulas recommended by the Massachusetts station, one by a Delaware station formula, and the other by our own.

7. Skim milk as a fertilizer. Applied by surface and subirrigation to various plants.

8. Soiling crops.

9. Variety test with three kinds of ensilage corn, Sanford, Leaming, and Mosby's Prolific.

10. Pasteurizing milk and cream.

11. Testing crimson clover by sowing it each month after July until cold weather.

12. Killing out wire grass by plowing and sowing ground to buckwheat.

13. Forestry. During the winter vacation a piece of our college forest, which was thick with dead trees and underbrush, was measured out and thinned, according to modern methods of forestry. The data have been preserved and will be published in due time. A quantity of lumber sufficient for general use upon the farm was also cut and sawed during the winter.

In carrying on the work in this division, the head of the department has been ably assisted by Ruel S. Alden, B. S., farm superintendent.

II. Horticulture

November first, a greenhouse, 25x45, was completed and it has answered as a vegetable forcing-house as well as for general floricultural plants. This being the first house, its space has been in great demand. With it we were able to carry on much work that would have been impossible without it.

Early in the winter plans for the season's work were drawn up and presented to the Station Council for approval. The work has been carried out as follows:

1. Testing varieties of vegetables. This work was made to cover the subject in a general way, as a beginning. The amount of this work in the future will depend upon the apparent value of it.

The kinds of vegetables and number of varieties of each grown at the station this past season, were as follows:

Tomatoes, 56; early and late cabbage, 28; pole and bush beans, 50; cauliflower, 18; celery, 18; sweet corn, 32; musk melon, 36; onion, 9; early and late peas, 34; cucumbers, 11; beets, 8; lettuce, 10; water melon, 11; egg plant, 4; pepper, 3; carrot, 4; parsnip, 6; pumpkin, 4; spinach, 3; salsify, 2; asparagus, 4.

Also one or two varieties of each of the following: Parsley, rhubarb, kale, leek, Kohl Rabi, endive, okra, pop-corn, broccoli, sea kale, cardoon, cress, turnip, radish, etc.

2. Small fruits. A list of small fruits was ordered and set out last spring, as follows:

Strawberries, 47 varieties; gooseberries, 13 varieties; blackberries, 17 varieties; black raspberries, 18 varieties; red raspberries, 15 varieties; currants, 11 varieties.

The strawberries cover one-fourth acre, while the other berries contain six plants of each variety. The plants, excepting strawberries, were received in rather poor condition, due to misshipment, and have not done well.

3. Plums. A test orchard of 40 different kinds of plums was set out last spring, one tree of each variety.

4. Vineyard. Forty-four varieties of grapes, three plants of each variety, have been set out.

5. Orchard fruits. We were unable to find time to do much with other tree fruits than plums this season. Most of the trees scattered about the farm are Baldwins, a few Greenings, Goddard, Nonesuch, Northern Spy, and Gravenstein. The trees are old but this season were very productive. At the present writing we have about three hundred barrels of apples. Last spring we received from the United States Department of Agriculture a donation of fifty-four scions of different varieties of apples, two of pears, and three Persian peach trees. All of the apples and pears were grafted on old trees, and most of them have united and are growing.

A few varieties of quinces were also set out.

6. Potatoes. A list of eighty of the more promising standard kinds, together with new varieties, was prepared for a variety test. Enough seed to plant a fifty-foot row of each variety was purchased, and the varieties were all given as nearly as possible the same conditions in planting, spraying, cultivating, and harvesting. The results are being compiled for future publication. These potatoes were exhibited at the State Grange and Rochester fairs.

7. Irrigation experiments. In the spring, considerable attention was given to mapping out some practical irrigation experiments.

8. Fertilizers in the greenhouse. Considerable work was done the past winter toward studying the subject of fertilizers for greenhouse soils, both in pots and boxes. One of the main objects was to find, if possible, a substitute in form of a commercial fertilizer for natural manures. This experiment is to be carried on throughout the coming winter, as a thesis subject by one of our seniors in agriculture.

9. Floricultural work. The work in floriculture has been general except in the case of sweet peas. A study was made of eighty varieties of these.

10. A study of the difference in effect of muriate and sulphate of potash upon potatoes.

11. Preventing potato scab by the use of corrosive sublimate.

12. Planning to build a new greenhouse and potting-room. The plans have been completed and the buildings are in process of erection.

The work in this division has been accomplished through the able assistance of Mr. Leigh Hunt, B. S., assistant horticulturist.

F. Wm. Rane,
Agriculturist and Horticulturist.

DONATIONS TO THE AGRICULTURAL AND HORTICULTURAL DEPARTMENT, NOVEMBER, 1895, TO NOVEMBER, 1896.

NAMES.	Number of Articles.	Kind of Donation.
A. T. Cook	5	New var. of vegetable seeds.
Currie Bros	4	New vegetable seeds and grain.
W. Atlee Burpee & Co	43	New vegetable and flower seeds.
Joseph Breck & Sons	36	New vegetable seeds.
H. A. Dreer	50	New vegetable and flower seeds.
A. W. Livingston & Sons	16	New vegetable seeds.
Perry Seed Store	1	New vegetable seeds.
James J. H. Gregory	18	New vegetable seeds.
Cole's Seed Store	5	New vegetable seeds.
J. L. Normand	1	Twenty Cassabanana seeds.
John A. Salzer Seed Co	4	Vegetable and flower seeds.
Peter Henderson & Co	18	Vegetable seeds.
Phœnix Nursery Co	2	New varieties grapes.
Sherman Nurseries (J. S. Kerr)	2	One new pear; one new plum.
D. Hill	50	Evergreens.
The Rogers Nursery Co	2	One new pear; one new plum.
W. W. Rawson & Co	2	Vegetable seeds.
Northwestern Seed Co	4	Vegetable and flower seeds.
C. H. Deitz	2	Varieties sugar beets.
Mr. E. Ray Shaw	3	Varieties Russia peas.
Mr Spaulding	1	Variety seedling musk melon.
E. P. Powell	19	Crosses of beans and s. corn.
Pomological Div., Washington, D. C.	59	Scions var. appl's, pears, peach's
T. O. Taylor	3	Corn and potatoes.

DEPARTMENT OF METEOROLOGY AND AGRICULTURAL ENGINEERING

1895–'96.

I. Meteorology

Regular observations of temperature, pressure, and weather have been carried on the past year, as begun the previous year and described in the last annual report. Weather flags have also been regularly displayed and during the summer months an extra set of flags has been loaned to Mr. Arioch W. Griffiths, who has displayed them from a tower on a hill near his residence at Packer's Falls. By the aid of a telescope he has read the signal-flags on the tower of the experiment station building, about two miles distant. The signals, as displayed in this locality, have been of service to an important farming section of this town, as well as to portions of Lee and Newmarket.

A few months since, a weather bulletin board was placed in position in the lower hall of the experiment station building, upon which the most important weather changes and reports are daily recorded for the benefit of the station staff.

Mr. James A. Foord, New Hampshire College, class of '98, has continued in charge of observations to the satisfaction of the department. During the summer vacation his duties were performed by Arthur Given, also of the class of '98.

The detailed record of observations taken will be found in the appendix.

II. Agricultural Engineering

This department has been called on by other departments of the station for a few surveys during the year but the most of its energy has been expended upon experimental road work. Grading and surfacing in different ways was carried on during portions of the summer upon a section of the highway, in front of the college property, about seven hundred feet in length. Through the kindness of Mr. M. H. Harlow, representing the Ingersoll-Sargeant Drill Co., a steam drill has been loaned the

college, and it has been used with much satisfaction through the season.

With the approval of the highway agents, a close watch has been kept upon the work done by them on the town roads, while the needs of these highways have been studied with the intention of reporting upon them at the close of the season. It is expected that the details of all this work, so far as they are of public interest, will be presented in bulletin form at a later date.

Popular talks on road construction and kindred topics have been given on seventeen occasions during the year.

C. H. Pettee,
Meteorologist.

DEPARTMENT OF BACTERIOLOGY

During the year ending October 31, 1896, this department has carried on experiments on tuberculosis, on the pasteurization of milk and cream, and the use of pure cultures of bacteria for the ripening of cream. Considerable work has been done also in the study and treatment of the fungous diseases of the apple and potato.

H. H. Lamson,
Bacteriologist.

DEPARTMENT OF ENTOMOLOGY

The four bulletins issued by the entomological department during the year have discussed at length six of the most destructive insects in New Hampshire, namely, the army worm, apple maggot, codling moth, sugar maple borer, tent caterpillar, and white-marked tussock moth. In addition to the work upon these subjects, the entomologist has given attention to a number of other injurious insects, bulletins upon which are in preparation. A summary of the more important insect injuries during the year will be found in the accompanying insect calendar for 1896.

Satisfactory studies of the life-histories of insects—studies which are essential to the best economic results—require careful and continuous attention from one whose time can be wholly devoted to the subject. The entomological department needs an assistant for such work, as the college duties of the entomologist require much time and frequent absences from town. During the past year occasional assistance has been rendered by students, especially Messrs. L. H. Kittredge and R. H. Shaw. The former has been especially helpful in making drawings for bulletin illustrations, and the latter in taking photographs for a similar purpose.

The Insect Record for 1896

The season of 1896, as far as insect outbreaks in New Hampshire are concerned, was especially notable for the continuance of the attack of the American tent caterpillar[1] and an invasion by the army worm[2]. I have treated of both of these pests quite fully in recent bulletins, The Tent Caterpillar forming the subject of Bulletin 38, and The Army Worm, of Bulletin 39. The former insect was even more destructive than during previous years and threatens to inflict still greater damage next spring. Perhaps the most notable feature of the outbreak is to be found in the extending range of food plants. Not content with the foliage of the apple and wild cherry, which from time immemorial seems to have formed the staple diet of these caterpillars, they are now attacking many other trees, being forced to this procedure because of the exhaustion of their own natural food supplies.

A statement of this phase of the outbreak is published in the bulletin, already mentioned, and a number of illustrations of it are there given. Figure 1 on next page shows the effect of tent caterpillar attack upon the barberry, a plant which ordinarily does not suffer such injury. It is evident that concerted action by communities is very desirable in subduing this pest which so greatly disfigures our highways, and so seriously injures our orchards.

[1] *Clisiocampa americana.*
[2] *Leucania unipuncta.*

Fig. 1. A barberry branch defoliated by tent caterpillars.

In the tent caterpillar bulletin, the natural enemies of the insect are briefly treated of. Since its publication I have received a letter from Mr. W. F. Fiske, of Mast Yard, New Hampshire, from which I am glad to extract this statement: "I do not think you lay enough stress on the value of the chickadee as an exterminator of the tent caterpillar. I have repeatedly seen them tear open the cocoon for the pupa contained therein, and have credited them with a great many cocoons thus opened, which I have seen. If in the neighborhood of infested orchards, these birds were fed in the winter and proper nesting places provided in the breeding season, it would be possible to colonize them there to the great benefit of the apple crop. A thick clump of spruces or other close-growing evergreens would be of good service to shelter the birds in the winter, and with good shelter and plenty of food they would not only be likely to colonize there in numbers, but it might also save the lives of individuals which would otherwise perish from exposure and lack of food." I am glad to

endorse these sentiments and recommendations. Few people realize the value of the birds which are already at work in our fields and orchards.

The CANKER WORM was very destructive in many parts of the state early in the summer. A great number of orchards showed by the seared foliage that this pest had been at work. We received many applications for information regarding methods of subduing it, but as too often happens, the questions generally were not asked until too late to prevent most of the injury. A bulletin giving a full account of the insect and the methods of preventing its injuries is in preparation, and we hope to issue it at an early date.

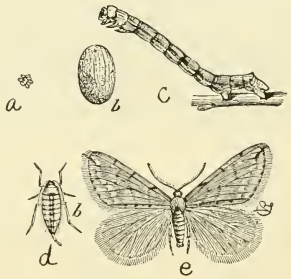

Fig. 2. The Spring Canker Worm

On account of the extraordinary abundance of the apple crop this year there was comparatively little complaint of the damage inflicted by the CODLING MOTH [1] and APPLE MAGGOT.[2] There were so many apples that the insects were only able to injure a small percentage of them and so were little noticed. Both of these pests are treated of in Bulletin 35, issued last May.

Some complaints were received during the season of injury to pastures and meadows by the WHITE GRUB, the young or larva of the MAY BEETLE, or JUNE BUG.[3]

The life history of this pest, briefly sketched, is this: The

[1] *Carposapsa pomonella.*
[2] *Trypeta pomonella.*
[3] *Lachnosterna fusca*, and other species.

brown beetles appear during May and June, and feed at night upon the foliage of various fruit and shade trees. They deposit small, whitish eggs among the roots of the grass. These eggs hatch into small, brown-headed grubs, that feed upon the roots about them. They continue feeding for two seasons, when they are full grown and form an oval cell in the soil and change to the pupa state, soon after transforming into beetles. The change to the pupa and beetle states generally occurs in the fall, the beetles remaining in the ground until the following spring, so that they are often turned up during late fall or early spring plowing.

This insect is one of the most difficult pests to fight of its class. It breeds especially in grass lands, and often ruins pastures and meadows, while crops planted on sod land are very frequently destroyed. There is much evidence to prove that with high farming and short rotations its injuries may largely be prevented. The parent beetles may be destroyed by spraying the trees on which they feed with London purple or Paris green. It will often pay, when land infested by these grubs is to be planted to strawberries or other crops which they are liable to injure, to have boys follow the plow and collect the grubs as they appear in the furrow. In this way a large amount of damage can frequently be prevented at very slight expense. The grubs in infested meadows may be destroyed by turning swine in the field.

Fig. 3. The Cabbage Root Maggot; *a*, larva; *b*, pupa; *c*, fly, magnified.

Much injury was done during spring and early summer by the CABBAGE ROOT MAGGOT [1]—one of the most vexatious enemies of the gardener. The adult (Fig. 3 *c*) is a small, two-winged fly,

[1] *Anthomyia brassicae.*

somewhat like the common house fly in general appearance, which appears in the cabbage field soon after the plants are set out, and deposits its eggs about the stems at the soil surface. The little, whitish maggots soon hatch, and work their way downward to the roots, which they attack, feeding upon the outer surface and thus making grooves, or boring into the interior and hollowing out cavities. The effect of their work is to remove the fibrous roots from the plant, so that when pulled up it resembles Fig. 4. In two or three weeks the maggots become full-fed (*a*), and they change to the pupa state within

Fig. 4. Young Cabbage Plant denuded of roots by maggots. (Original.)

hard brown puparia (*b*), to emerge some days afterward as adult flies. There are probably three or four broods each season, and the insect apparently hibernates in each of its three later stages.

Considerable damage was reported early in the season from the work of various species of cut worms. The same weather conditions that favored the development of the army worm, doubtless led to an unusual abundance of these closely related pests.

CLARENCE M. WEED,
Entomologist.

63973 N53 1 copy
New Hampshire
Bulletins 1-48